~~08 227075~~

08/782866

PATENT

Docket No. GV-2166

Box Patent Application
Commissioner of Patents and Trademarks
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): Paul Delabastita, Johan Van Hunsel and Frank Schelfaut

WARNING: *Patent must be applied for in the name(s) of all of the actual inventor(s). 37 CFR 1.41(a) and 1.53(b).*

For (title): Method For Making A Lithographic Printing Plate

1. Type of Application

This new application is for a(n) (*check one applicable item below*):

☒ Original

☐ Design

☐ Plant

WARNING: *Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. 371(c)(4) unless the International Application is being filed as a divisional, continuation or continuation-in-part application.*

NOTE: *If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.*

☐ Divisional

☐ Continuation

☐ Continuation-in-part (CIP)

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this New Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date April 13, 1994 in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EF413577190 addressed to the: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Richard J. Birch
(*type or print name of person mailing paper*)

(*Signature of person mailing paper*)

NOTE: *Each paper or fee referred to as enclosed herein has the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 CFR 1.10(b).*

2. Benefit of Prior U.S. Application(s) (35 U.S.C. 120)

NOTE: If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

☐ The new application being transmitted claims the benefit of prior U.S. application(s) and enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed Which Are Required For Filing Date Under 37 CFR 1.53(b) (Regular) or 37 CFR 1.153 (Design) Application

_17_ Pages of specification

_2_ Pages of claims

_1_ Pages of Abstract

_3_ Sheets of drawing

☐ formal

☒ informal

WARNING: DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. Comments on proposed new 37 CFR 1.84. Notice of March 9, 1988 (1990 O.G. 57-62).

NOTE: "Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page." 37 C.F.R. 1.84(c)).

(complete the following, if applicable)

☐ The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)". 37 C.F.R. 1.84(b).

4. Additional papers enclosed

☐ Preliminary Amendment

☐ Information Disclosure Statement (37 CFR 1.98)

☐ Form PTO-1449

☐ Citations

☐ Declaration of Biological Deposit

☐ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.

☐ Authorization of Attorney(s) to Accept and Follow Instructions from Representative

☐ Special Comments

☐ Other

5. Declaration or oath

☒ Enclosed

executed by *(check all applicable boxes)*

☒ inventor(s).

☐ legal representative of inventor(s). 37 CFR 1.42 or 1.43

☐ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.

☐ this is the petition required by 37 CFR 1.47 and the statement required by 37 CFR 1.47 is also attached. *See item 13 below for fee.*

☐ Not Enclosed.

WARNING: Where the filing is a completion in the U.S. of an International Application but where a declaration is not available or where the completion of the U.S. application contains subject matter in addition to the International Application the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

☐ Application is made by a person authorized under 37 CFR 1.41(c) on behalf of *all the above named inventor(s).* (The declaration or oath, along with the surcharge required by 37 CFR 1.16(e) can be filed subsequently).

NOTE: It is important that all the correct inventor(s) are named for filing under 37 CFR 1.41(c) and 1.53(b).

☐ Showing that the filing is authorized. (*Not required unless called into question. 37 CFR 1.41(d).*

6. Inventorship Statement

WARNING: If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.

The inventorship for all the claims in this application are:

☒ The same

or

☐ Are not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted.

☐ will be submitted.

7. Language

NOTE: An application including a signed oath or declaration may be filed in a language other than English. A verified English translation of the non-English language application and the processing fee of $130.00 required by 37 CFR 1.17(k) is required to be filed with the application or within such time as may be set by the Office. 37 CFR 1.52(d).

NOTE: A non-English oath or declaration in the form provided or approved by the PTO need not be translated. 37 CFR 1.69(b).

☒ English

☐ non-English

☐ the attached translation is a verified translation. 37 CFR 1.52(d).

8. Assignment

☒ An assignment of the invention to AGFA-GEVAERT

☒ is attached. A separate ☒ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

☐ will follow.

NOTE: *"If an assignment is submitted with a new application, send two separate letters-one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).*

WARNING: *A newly executed "CERTIFICATE UNDER 37 CFR 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.*

9. Certified Copy

Certified copy(ies) of application(s)

(country)	(appln. no.)	(filed)
European	93201115.8	April 16, 1993

from which priority is claimed

☒ is (are) attached.

☐ will follow.

NOTE: *The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 CFR 1.55(a) and 1.63.*

NOTE: *This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. 120 is itself entitled to priority from a prior foreign application then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.*

10. Fee Calculation (37 CFR 1.16)

A. ☒ Regular application

CLAIMS AS FILED

Number filed		Number Extra		Rate	Basic Fee 37 CFR 1.16(a) $710.00
Total Claims (37 CFR 1.16(c)) 7	−20=	0	X	$ 22.00	0
Independent Claims (37 CFR 1.16(b)) 1	−3=	0	X	$ 74.00	0
Multiple dependent claim(s), if any (37 CFR 1.16(d))			+	$230.00	

☐ Amendment cancelling extra claims enclosed.

☐ Amendment deleting multiple-dependencies enclosed.

☐ Fee for extra claims is not being paid at this time.

NOTE: *If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 CFR 1.16(d).*

Filing Fee Calculation $ 710.00

B. ☐ Design application
($290.00—37 CFR 1.16(f))

Filing Fee Calculation $______

C. ☐ Plant application
($480.00—37 CFR 1.16(g))

Filing fee calculation $______

11. Small Entity Statement(s)

☐ Verified Statement(s) that this is a filing by a small entity under 37 CFR 1.9 and 1.27 is(are) attached.

Filing Fee Calculation (50% of A, B or C above) $______

NOTE: *Any excess of the full fee paid will be refunded if a verified statement and a refund request are filed within 2 months of the date of timely payment of a full fee. 37 CFR 1.28(a).*

12. Request for International-Type Search (37 CFR 1.104(d)) *(complete, if applicable)*

☐ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made At This Time

☐ Not Enclosed

☐ No filing fee is to be paid at this time. (*This and the surcharge required by 37 CFR 1.16(e) can be paid subsequently.*)

☒ Enclosed

☒ basic filing fee $ 710.00

☒ recording assignment
($40.00; 37 CFR 1.21(h)) (See attached "COVER SHEET FOR ASSIGNMENT ACCOMPANYING NEW APPLICATION".)

☐ petition fee for filing by other than all the inventors or person on behalf of the inventor where inventor refused to sign or cannot be reached. ($130.00; 37 CFR 1.47 and 1.17(h)) $______

☐ for processing an application with a specification in a non-English language. ($130.00; 37 CFR 1.52(d) and 1.17(k) $______

☐ processing and retention fee
($130.00; 37 CFR 1.53(d) and 1.21(l))

☐ fee for international-type search report ($40.00; 37 CFR 1.21(e)). $______

NOTE: *37 CFR 1.21(l) establishes a fee for processing and retaining any application which is abandoned for failing to complete the application pursuant to 37 CFR 1.53(d) and this, as well as the changes to 37 CFR 1.53 and 1.78, indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid or the processing and retention fee of § 1.21(l) must be paid within 1 year from notification under § 53(d).*

Total fees enclosed $ 750.00

14. Method of Payment of Fees

☒ Check in the amount of $ 710.00 & 40.00

☐ Charge Account No. ______________ in the amount of $______________. A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 CFR 1.22(b).

15. Authorization to Charge Additional Fees

WARNING: If no fees are to be paid on filing the following items should not be completed.

WARNING: Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

☒ The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 02-2445:

☒ 37 CFR 1.16(a), (f) or (g) (filing fees)

☐ 37 CFR 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 CFR 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

☐ 37 CFR 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

☒ 37 CFR 1.17 (application processing fees)

WARNING: While 37 CFR 1.17(a), (b), (c) and (d) deal with extensions of time under § 1.136(a) this authorization should be made only with the knowledge that: "Submission of the appropriate extension fee under 37 C.F.R. 1.136(a) is to no avail unless a request or petition for extension is filed." (Emphasis added). Notice of November 5, 1985 (1060 O.G. 27).

☐ 37 CFR 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 CFR 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 CFR 1.311(b).

NOTE: 37 CFR 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . issue fee". From the wording of 37 CFR 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

16. Instructions As To Overpayment

☒ Credit Account No. 02-2445

☐ Refund

SIGNATURE OF ATTORNEY

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☐ **Incorporation by reference of added pages**

Check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED

☐ Plus Added Pages For New Application Transmittal Where Benefit Of Prior U.S. Application(s) Claimed

Number of pages added ____________

☐ Plus Added Pages For Papers Referred To In Item 4 Above

Number of pages added ____________

☒ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added 2

☐ **Statement Where No Further Pages Added**

(If no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item:)

☐ This transmittal ends with this page.

GV2166

3 drawings

7/0,688 ~~2270/75~~
~~5/3695~~
782866

DESCRIPTION

C17

1. Field of the invention.

The present invention relates to a method for making a lithographic printing plate, in particular to a method wherein a lithographic printing plate precursor is scan-wise exposed.

2. Background of the invention.

Lithographic printing is the process of printing from specially prepared surfaces, some areas of which are capable of accepting ink (oleophilic areas) whereas other areas will not accept ink (oleophobic areas). The oleophilic areas form the printing areas while the oleophobic areas form the background areas.

Two basic types of lithographic printing plates are known. According to a first type, so called wet printing plates, both water or an aqueous dampening liquid and ink are applied to the plate surface that contains hydrophilic and hydrophobic areas. The hydrophilic areas will be soaked with water or the dampening liquid and are thereby rendered oleophobic while the hydrophobic areas will accept the ink. A second type of lithographic printing plates operates without the use of a dampening liquid and are called driographic printing plates. This type of printing plates comprise highly ink repellant areas and oleophilic areas. Generally the highly ink repellant areas are formed by a silicon layer.

Lithographic printing plates can be prepared using a photosensitive lithographic printing plate precursor, also called imaging element. Such imaging element is exposed in accordance with the image data and is generally developed thereafter so that a differentiation results in ink accepting properties between the exposed and unexposed areas.

Examples of photosensitive lithographic printing plate precursors are for example the silver salt diffusion transfer (hereinafter DTR) materials disclosed in EP-A-410500, EP-A-483415, EP-A-423399, imaging elements having a photosensitive layer containing diazonium salts or a diazo resin as described in e.g. EP-A-450199, imaging elements having a photosensitive layer containing a photopolymerizable composition as described in e.g. EP-A-502562, EP-A-491457, EP-A-503602, EP-A-471483 or DE-A-4102173.

Alternatively a lithographic printing plate may be prepared from

a heat mode recording material as a lithographic printing plate precursor. Upon application of a heat pattern in accordance with image data and optional development the surface of such heat mode recording material may be differentiated in ink accepting and ink repellant areas. The heat pattern may be caused by a direct heating source such as a thermal head but may also be caused by a light source as e.g. a laser. In the latter case the heat mode recording material will include a substance capable of converting the light into heat. Heat mode recording materials that can be used for making a lithographic printing plate precursor are described in e.g. EP-A-92201633, DE-A-2512038, FR-A-1.473.751, Research Disclosure 19201 of april 1980 or Research Disclosure 33303 of January ~~januari~~ 1992.

From the above it will be clear that lithographic printing is only capable of reproducing two tone values because the areas will accept~~ant~~ ink or not. Thus lithographic printing is a so called binary process. In order to reproduce originals having continuously ~~contiuously~~ changing tone values by such process halftone screening techniques are applied.

In a commonly used halftone screening technique, the continuously changing tone values of the original are modulated with periodically changing tone values of a superimposed two-dimensional screen. The modulated tone values are then subject to a thresholding process wherein tone values above the threshold ~~treshold~~ value will be reproduced and those below will not be reproduced. The process of tone-value modulation and thresholding results in a two-dimensional arrangement of equally spaced "screen dots" whose dimensions are proportional to the tone value of the original at that particular location. The number of screen dots per unit distance determines the screen frequency or screen ruling. This screening technique wherein the screen frequency is constant and inversely proportional to the halftone cell size and, hence, to the maximum density of the screen dot, is referred to as amplitude-modulation screening or autotypical screening. This technique can be implemented photo-mechanically or electronically.

The photo-mechanical implementation involves an analog process wherein a screen of equally spaced dots is physically superimposed, in contact or in projection with the original. Screen dots are formed when this combination is photographically reproduced in a system wherein thresholding is achieved through the use of special photographic films and developing chemicals producing a very high photographic contrast resulting a sharp distinction between tone

values above and below a certain level.

The electronic implementation of autotypical screening is a digital process wherein the continuous tone values of the original are broken up into discrete tone-value levels, specified at discrete areal coordinates within the original image. Each tone value is compared with an electronic threshold level, and values above the threshold are reproduced while those below the threshold are not. Screen dots are formed when a specific pattern of threshold values is defined in a two-dimensional array corresponding to the size of a halftone cell, and this threshold pattern is periodically applied ac~~c~~ross the image.

It will further be clear that in order to reproduce a color image using lithographic printing it will be required to separate the image in three or more part-images corresponding to primary colors that when printed over each other yield the desired color at any place within the image. Each of these color separation has to be screened as described above.

It is well known that the above described procedure of screening and color separation results in certain artifacts on a copy obtained in lithographic printing. Such artifacts are e.g. enlarging of the screen dots on the press, Moiré patterns, color shifts etc.. Due to the complex and critical nature of lithographic printing of continuous tone originals and in particular color originals ~~original~~ the need exists for a preview of the final result.

Of course, in order to make such preview one could make a proof print under the same conditions as those intended for the final printing. However such would be very time consuming and expensive. Thus proof printing materials have been developed to simulate the final print including artifacts that are expected to occur in the final print.

Such proofing materials are designed to be used in conjunction with the photographic films also used to make the final printing plates. As a consequence they are only suitable for the proofing of printing plates that are obtained by camera-exposure or contact exposures of imaging elements.

The above proofing materials are generally not suitable for proofing the printing results of plates that are obtained by scan exposure of an imaging element under the control of a computer. Such procedure is called computer-to-plate and obviates the need for photographic films since the image data being in a digital form is used to directly expose the imaging element. The exposure is

carried out by an output device such as e.g. a laser, LED or Cathode Ray Tube, that scans over the imaging element and exposes it according to the digital image data.

Thus for the latter type of printing plates special Direct Digital Proofing (DDP) techniques were developed to generate a printing proof. However because several types of artifacts have to be simulated it can be understood that DDP-techniques include a high degree of sophistication and as a result are expensive.

3. Summary of invention.

It is an object of the present invention to provide a method for making a lithographic printing plate by means of scan-exposure of a lithographic printing plate precursor and wherein the printing results can be previewed in a less expensive and convenient way.

Further objects of the present invention will become clear from the description hereinafter.

According to the present invention there is provided a method for making a lithographic printing plate from an original containing continuous tones comprising the steps of:

- screening said original to obtain screened data
- scan-wise exposing a lithographic printing plate precursor according to said screened data, said lithographic printing plate precursor having a surface capable of being differentiated in ink accepting and ink repellant areas upon said scan-wise exposure and an optional development step and
- optionally developing a thus obtained scan-wise exposed lithographic printing plate precursor,

characterized in that said screening is a frequency modulation screening.

4. Brief description of the drawings.

The present invention is illustrated by way of example and without the intention to limit the invention thereto with the following drawings:

~~Figure 1 shows a Hilbert curve before (a) and after randomization (b).~~

Figure 2 shows the order of processing image pixels when the image is recursively subdivided into matrices.

Figure 3 shows a schematic representation of a circuit for

implementing a halftoning method according to the invention.

5. Detailed description of the invention.

Frequency modulation screening is a technique in which the continuously changing tone values of an original are reproduced by means of equally sized micro dots, the number of which is proportional to the tone value of the original image. The name frequency modulation refers to the fact that the number of micro dots per unit surface (the frequency) fluctuates in proportion to the tone value in that same area.

As a consequence of the use of frequency modulation screening for exposing a lithographic printing plate precursor the printing results obtained from such a plate could well be simulated by less expensive, less complex and even relatively low resolution systems (in comparison with lithographic printing). Examples of such systems that can be used for generating a printing proof are ink-jet printers, Xerographic printers and thermal wax printers. It is even possible to use a printing device such as a thermal sublimation printing device that in itself does not require screening to yield a continuous tone image.

A suitable frequency modulation screening technique for use in connection with the present invention is the well-known Error diffusion first described by Floyd and Steinberg "An adaptive algorithm for spatial grey scale" SID 75 Digest. Society for information display 1975, pp. 36-37. According to the error diffusion technique the image pixels of a continuous tone image are processed one after the other according to a predetermined path e.g. from left to right and top to bottom.

The tone value of each image pixel is thereby compared with a threshold value which is generally the tone value half-way the tone scale e.g. 128 when the tones of the image-pixels range from 0 to 256. Depending on whether the tone value of the image pixel is above or below the threshold value a halftone dot will be set or not in the corresponding reproduction of the image pixel. The resulting error or weighted error, i.e. the difference between the reproduction value and actual value of the image pixel, is then added to the tone value of one or more neighbouring image pixels that are still unprocessed. Details about the error diffusion screening method may be found in the aforementioned reference or in US-P-5.175.804.

A more preferred variant of frequency modulation screening for use in connection with the present invention is a method similar to the error diffusion with the exception that the order in which the image pixels are processed can be described by a space filling deterministic fractal curve or a randomized space filling curve.

This type of frequency modulation screening comprises the following steps:

- selecting an unprocessed image pixel according to a space filling deterministic fractal curve or a randomized space filling curve and processing said unprocessed image pixel as follows:
- determining from the tone value of said unprocessed image pixel a reproduction value to be used for recording said image pixel on a lithographic printing plate precursor,
- calculating an error value on the basis of the difference between said tone value of said unprocessed image pixel and said reproduction value, said unprocessed image pixel thereby becoming a processed image pixel,
- adding said error value to the tone value of an unprocessed image pixel and replacing said tone value with the resulting sum or alternatively distributing said error value over two or more unprocessed image pixels by replacing the tone value of each of said unprocessed image pixels to which said error value will be distributed by the sum of the tone value of the unprocessed image pixel and part of said error,
- repeating the above steps until all image pixels are processed.

A suitable deterministic fractal curve is for example the so called "Hilbert Curve" disclosed by Witten Ian H., and Radford M. Neal, "Using Peano Curves for Bilevel Display of Continuous-Tone Images", IEEE CG&A, May 1982, pp. 47-52.

According to the most preferred embodiment of the present invention the order of processing the image pixels is ruled by a randomized space filling curve. With the term "randomized space filling curve" is meant that the processing of the image pixels follows basically a pre-determined curve that assures that each image pixel will be processed but which curve is randomized at a number of points so that patterns are avoided.

Such randomized space filling curve can be obtained in different ways. For example the Hilbert Curve may be used as the pre-determined curve on which randomization is performed. A computer program that can be used to obtain a randomized Hilbert Curve is shown in annex 1. Figure 1 gives a visualization of a Hilbert Curve

before and after randomization. The randomization of the Hilbert Curve may be carried out by following the curve and at every point of the curve deciding at random whether or not the curve will be permutated at the particular point.

According to an alternative a randomized space filling curve may be obtained by dividing the image into matrices of image pixels. Within each of these matrices the image pixels are processed at random until all image pixels are processed. The order in which the matrices are processed may then be selected at random or in a predetermined way.

An alternative to the above method of dividing the image into matrices is the recursively division of the image into smaller matrices until the size of a matrix reaches an image pixel. At every subdivision into smaller submatrices a random ordering of processing the matrices is assigned to every submatrix. Annex 2 shows a computer program that can be used to carry out this process and figure 2 shows the resulting order in which image pixels are processed in this case. It will be clear that this method works well for square image but imposes problems for other images. To overcome this problem the original image may be padded with ~~zeors~~ zeros along its longest side until a square is obtained. In a second approach, a path may be calculated with the size of the longest rectangular image. The points of the path that do not belong to the image may then be skipped during processing.

Figure 3 shows a circuit to perform a frequency modulation screening in combination with a binary recording device, e.g. an image-setter. First the different building blocks of this circuit are described, later on its operation will be explained.

Block (20) is a memory block containing the contone pixel values of an image. Typically these are 8 bit values, organized as N lines with M columns. Block (30) is a memory block with the same lay out as block (20), in which the the halftoned pixel values will be stored. In the case of a binary recording device, every halftoned pixel word has a length of 1 bit. Block (80) is a device capable of scan-wise exposing a substrate i.e. a lithographic printing plate precursor using the information in block (30). Block (70) is an arithmetic unit capable of calculating the sum of the pixelvalue P(i,j) and the error E at the output of a delay register (60). The conversion of a contone pixel value into a halftoned pixel value takes place in block (40). This conversion may be based on a thresholding operation: if the contone value at point (i,j) is below

the value of 128, a value "0" is stored in the halftone memory, otherwise a "1" is stored. Block (50) contains an arithmetic unit that is capable to calculate the error between the original contone value, and the halftoned pixel value, and to store it in the delay register (60). Block (8) is a counter that sequences the processing of the N*M pixels of the image. Block (10) is LUT with N*M entries (one for every image pixel), and a UNIQUE combination of a row and column address that corresponds with one pixel position in the image. Block (5) is a clock.

The table of block (10) thus holds the order in which the image pixels will be processed. This table may be calculated according to one of the methods described above.

The operation of the diagram is now explained. At every clock pulse, the counter (8) is incremented, and a new pair of coordinates (i(n),j(n)) is obtained from block (10). These coordinates are used as address values to the pixel memory (20), to obtain a contone pixel value P(i(n),j(n)). This pixel value is immediately added to the error E(i(n-1),j(n-1)), that was stored in register (60) after the previous halftone step, and the sum of both is compared to the threshold value (41) in block (40). The outcome of the thresholding operation determines the value H(i(n),j(n)) that will be written into the halftone pixel memory at position (i(n),j(n)). At the same time a new error E(i(n),j(n)) is calculated from the difference between P(i(n),j(n)) and H(i(n),j(n)), and stored in the delay register (60). The circuit is initialized by setting the counter (8) to 1, the error to 128, and the operation is terminated when the counter reaches the level N*M. After that, the halftone memory (30) is read out line by line, column by column, and its contents are recorded on a lithographic printing plate precursor by the recorder (80).

According to a variant of the above circuit the error that is obtained from the difference between the contone pixel and the halftoned pixel value, may, instead of being diffused only to the next pixel in the order of processing, diffused to more than one of the unprocessed pixels. Instead of using the error of one pixel, one may also use an average error of a number of pixels.

In case of a color image, the above described screening process is performed on each of the color separations of the image. Preferably the color image is separated in its Yellow, Magenta, Cyan and Black (CMYK) components. Each of these components may then be screened according to the present invention and used to scan-wise

expose four lithographic printing plate precursors. Four lithographic printing plates, one for each color separation, will thus be obtained. The color separations can then be printed over each other in register in a lithographic printing machine using the four plates.

According to a preferred embodiment of the present invention the CMYK color separations are prepared starting from a device independent representation of the color image. In a device independent color representation each color of an image is uniquely defined by device independent color coordinates within the color spectrum. Such device independent color coordinates are e.g. CIEXYZ or CIEL*a*b*.

From this device independent color coordinates may then be calculated the CMYK separations which are device dependent color signals for controlling a color reproduction device. This conversion is performed in such a way that the reproduction of a color will match the target color as close as possible.

To obtain a device independent color representation of an image a conversion of the device dependent color information obtained from an input device such as a color scanner a similar conversion but in the opposite direction will be necessary.

A method for performing these conversions is disclosed in EP-A-92115339.1. Such method uses conversion tables specific for each particular input or output device to convert the device dependent color image signals into device independent color signals and vice versa.

The method of the present invention can be used with lithographic printing plate precursors having a surface that can be differentiated upon image-wise exposure and an optional development step. Examples of printing plate precursors that can be used in connection with the present invention are printing plate precursors having a photosensitive layer or a heat mode recording layer.

A particular suitable printing plate precursor or imaging element is a so called mono-sheet DTR material. Two variants of such mono-sheet DTR material for making a lithographic printing plate are known and can be used.

A first type of mono-sheet DTR material comprises on a support in the order given a silver halide emulsion layer and an image receiving layer containing physical development nuclei e.g. a heavy metal sulphide as e.g. PdS. The image receiving layer is preferably free of binder or contains a hydrophilic binder in amount of not

more than 30% by weight. Subsequent to image-wise exposure the mono-sheet DTR material is developed using an alkaline processing liquid in the presence of developing agents e.g. of the hydroquinone type and/or pyrazolidone type and a silver halide solvent such as e.g. a thiocyanate. Subsequently the plate surface is neutralized with a neutralizing liquid. Details about the consitution of this type of mono-sheet DTR material and suitable processing liquids can be found in e.g. EP-A-423399, US-P-4.501.811 and US-P-4.784.933. Lithographic printing plate precursors of this type are marketed by Agfa-Gevaert NV under the name SETPRINT.

These type of printing plate precursors can be exposed using a laser or LED containing device. Examples of HeNe laser containing exposure units are the image-setters LINOTRONIC 300, marketed by LINOTYPE-HELL Co, and Select 5000/7000, marketed by Miles Inc.. An image-setter provided with an Ar ion laser that can be used is LS 210, marketed by Dr-Ing RUDOLF HELL GmbH. Exposure units provided with a laserdiode that can be used are LINOTRONIC 200, marketed by LINOTYPE-HELL Co, and ACCUSET marketed by Miles Inc..

The second type of mono-sheet DTR material also suitable for use in connection with the present invention comprises on an roughened and anodized aluminium support in the order given an image receiving layer as described above, a hydrophilic layer and a silver halide emulsion layer. Subsequent to image-wise exposure the mono-sheet DTR material is developed using an alkaline processing liquid in the presence of developing agents e.g. of the hydroquinone type and/or pyrazolidone type and a silver halide solvent such as e.g. a thiocyanate. Thereafter the plate is rinsed with water, preferably warm water, to remove the silver halide emulsion layer and hydrophilic layer. The obtained silver image in the image receiving may further be treated with a hydrophobizing liquid containing hydrophobizing agents to improve the ink accepting properties of the silver image. Details about the constitution, processing liquid and method for developing the mono-sheet DTR material may be found in EP-A-410500 and EP-A-483415. Because of the stifness of the aluminium support this type of imaging element is preferably exposed using a flat-bed scanner.

An other type of imaging element suitable for use in connection with the present invention is one comprising on a support having a hydrophilic surface or being coated with a hydrophilic layer a photosensitive layer containing a diazo resin, diazonium salt or a photopolymerizable composition. Such type of printing plate

precursors are disclosed in EP-A-450199, EP-A-502562, EP-A-487343, EP-A-491457, EP-A-503602, EP-A-471483, DE-A-4102173, Japanese patent application laid open to public inspection number 244050/90 etc.. Subsequent to the exposure these printing plate precursors are developed using plain water, a developing liquid being generally a mixture of water and one or more organic solvents or some of them may be developed using a delamination foil.

An imaging element suitable for use in connection with the present invention and that can be used to yield driographic printing plates is disclosed in e.g. EP-A-475384, EP-A-482653, EP-A-484917 etc..

It is also possible to use imaging elements having a heat mode recording layer. Such heat mode recording layer is a layer containing a substance that is capable of converting light into heat. Examples of heat mode recording layers are e.g. vacuum or vapour deposited Bismuth or Aluminium layers, layers containing infra-red dyes or pigments, layers containing carbon black etc.. Suitable heat mode recording materials for use in connection with the present invention are described in e.g. EP-A-92201633, DE-A-2512038, FR-A-1.473.751, Research Disclosure 19201 of april 1980 or Research Disclosure 33303 of januari 1992.

The latter two heat mode recording materials do not require a developing step or can be developed by simply cleaning the heat mode recording material with e.g. a dry cotton pad.

Suitable devices for scan-wise exposure of a lithographic printing plate precursor are e.g. Cathode Ray Tubes, LED's or lasers. Most preferably used devices are lasers, the particular type of laser and power being dependent on the type of printing plate precursor. Generally a lithographic printing plate precursor based on a silver halide photosensitive layer will require less powerful lasers while heat mode recording materials will generally require powerful lasers.

Examples of lasers that can be used in connection with the present invention are e.g. He/Ne lasers, Argon ion lasers, semiconductor lasers, YAG lasers e.g. Nd-YAG lasers etc..

CLAIMS

1. A method for making a lithographic printing plate from an original containing continuous tones comprising the steps of:
- screening said original to obtain screened data
- scan-wise exposing a lithographic printing plate precursor according to said screened data, said lithographic printing plate precursor having on a support a surface capable of being differentiated in ink accepting and ink repellant areas upon said scan-wise exposure and an optional development step and
- optionally developing a thus obtained scan-wise exposed lithographic printing plate precursor,
characterized in that said screening is a frequency modulation screening.

2. A method according to claim 1 wherein said frequency modulation screening proceeds according to the following steps:
- selecting an unprocessed image pixel according to a space filling deterministic fractal curve or a randomized space filling curve and processing said unprocessed image pixel as follows:
- determining from the tone value of said unprocessed image pixel a reproduction value to be used for recording said image pixel on a recording medium,
- calculating an error value on the basis of the difference between said tone value of said unprocessed image pixel and said reproduction value, said unprocessed image pixel thereby becoming a processed image pixel,
- adding said error value to the tone value of an unprocessed image pixel and replacing said tone value with the resulting sum or alternatively distributing said error value over two or more unprocessed image pixels by replacing the tone value of each of said unprocessed image pixels to which said error value will be distributed by the sum of the tone value of the unprocessed image pixel and part of said error,
- repeating the above steps until all image pixels are processed.

3. A method according to claim 2 wherein said original having continuous tones is subdivided in matrices of unprocessed image pixels and all of said image pixels within a matrix is processed before a subsequent matrix is processed.

4. A method according to claim 1 wherein said lithographic printing plate precursor contains a photosensitive layer.

5. A method according to claim 1 wherein said lithographic printing plate precursor contains a heat mode recording layer containing a substance capable of converting light into heat.

6. A method according to claim 1 wherein said lithographic printing plate precursor contains a silver halide emulsion layer and an image receiving layer containing physical development nuclei and wherein subsequent to said scan-wise exposure said lithographic printing plate is developed using an alkaline processing liquid in the presence of developing agent(s) and silver halide solvent(s).

7. A method according to claim 1 wherein said scan-wise exposure is carried using a laser or LED.

add E'

Annex 1

```
typedef struct {
 int i;
 int j;
 } Index;

typedef struct {
 Index pt1;
 Index pt2;
 Index pt3;
 Index pt4;
 } Hilbert_Elem;

store_hilbert_elem(it,p)
 Itile *it;
 Hilbert_Elem *p;
{
static int n=0;
it->elem[n][0] = p->pt1.i; it->elem[n][1] = p->pt1.j; n++;
it->elem[n][0] = p->pt2.i; it->elem[n][1] = p->pt2.j; n++;
it->elem[n][0] = p->pt3.i; it->elem[n][1] = p->pt3.j; n++;
it->elem[n][0] = p->pt4.i; it->elem[n][1] = p->pt4.j; n++;
}

/*** Initiation for Recursive Calculation of Hilbert Scan ***/
hilbert_initiation(size,p)
 int size; Hilbert_Elem *p;
{
p->pt1.i = 1*size/4; p->pt1.j = 1*size/4;
p->pt2.i = 1*size/4; p->pt2.j = 3*size/4;
p->pt3.i = 3*size/4; p->pt3.j = 3*size/4;
p->pt4.i = 3*size/4; p->pt4.j = 1*size/4;
}
```

```
/*** Recursive Module to Calculate Hilbert Scan ***/
hilbert_propagation(it,p)
 Itile *it;
 Hilbert_Elem *p;
{
int i1,j1,i2,j2,i4,j4,l,li,lj,si,sj,orientation,length;
Hilbert_Elem p1,p2,p3,p4;

i1 = p->pt1.i;
j1 = p->pt1.j;
i2 = p->pt2.i;
j2 = p->pt2.j;
i4 = p->pt4.i;
j4 = p->pt4.j;

li = (i4 - i1)/2.0;
lj = (j4 - j1)/2.0;

orientation = (i4-i1)*(j2-j1) - (j4-j1)*(i2-i1);
l = (int)sqrt((double) li*li + lj*lj);

if(orientation < 0)
 {
 p1.pt1.i = p->pt1.i;           p1.pt1.j = p->pt1.j;
 p1.pt1.i -= (li+lj)/2.0;       p1.pt1.j -= (li+lj)/2.0;
 p1.pt2.i = p1.pt1.i+li;        p1.pt2.j = p1.pt1.j+lj;
 p1.pt3.i = p1.pt2.i+lj;        p1.pt3.j = p1.pt2.j-li;
 p1.pt4.i = p1.pt3.i-li;        p1.pt4.j = p1.pt3.j-lj;

 p2.pt1.i = p1.pt4.i+lj;        p2.pt1.j = p1.pt4.j-li;
 p2.pt2.i = p2.pt1.i+lj;        p2.pt2.j = p2.pt1.j-li;
 p2.pt3.i = p2.pt2.i+li;        p2.pt3.j = p2.pt2.j+lj;
 p2.pt4.i = p2.pt3.i-lj;        p2.pt4.j = p2.pt3.j+li;

 p3.pt1.i = p2.pt4.i+li;        p3.pt1.j = p2.pt4.j+lj;
 p3.pt2.i = p3.pt1.i+lj;        p3.pt2.j = p3.pt1.j-li;
 p3.pt3.i = p3.pt2.i+li;        p3.pt3.j = p3.pt2.j+lj;
 p3.pt4.i = p3.pt3.i-lj;        p3.pt4.j = p3.pt3.j+li;

 p4.pt1.i = p3.pt4.i-lj;        p4.pt1.j = p3.pt4.j+li;
 p4.pt2.i = p4.pt1.i-li;        p4.pt2.j = p4.pt1.j-lj;
```

```
 p4.pt3.i = p4.pt2.i-lj;          p4.pt3.j = p4.pt2.j+li;
 p4.pt4.i = p4.pt3.i+li;          p4.pt4.j = p4.pt3.j+lj;
 }
else
 {
 p1.pt1.i = p->pt1.i;             p1.pt1.j = p->pt1.j;
 p1.pt1.i -= (li+lj)/2.0;         p1.pt1.j -= (li+lj)/2.0;
 p1.pt2.i = p1.pt1.i+li;          p1.pt2.j = p1.pt1.j+lj;
 p1.pt3.i = p1.pt2.i-lj;          p1.pt3.j = p1.pt2.j+li;
 p1.pt4.i = p1.pt3.i-li;          p1.pt4.j = p1.pt3.j-lj;

 p2.pt1.i = p1.pt4.i-lj;          p2.pt1.j = p1.pt4.j+li;
 p2.pt2.i = p2.pt1.i-lj;          p2.pt2.j = p2.pt1.j+li;
 p2.pt3.i = p2.pt2.i+li;          p2.pt3.j = p2.pt2.j+lj;
 p2.pt4.i = p2.pt3.i+lj;          p2.pt4.j = p2.pt3.j-li;

 p3.pt1.i = p2.pt4.i+li;          p3.pt1.j = p2.pt4.j+lj;
 p3.pt2.i = p3.pt1.i-lj;          p3.pt2.j = p3.pt1.j+li;
 p3.pt3.i = p3.pt2.i+li;          p3.pt3.j = p3.pt2.j+lj;
 p3.pt4.i = p3.pt3.i+lj;          p3.pt4.j = p3.pt3.j-li;

 p4.pt1.i = p3.pt4.i+lj;          p4.pt1.j = p3.pt4.j-li;
 p4.pt2.i = p4.pt1.i-li;          p4.pt2.j = p4.pt1.j-lj;
 p4.pt3.i = p4.pt2.i+lj;          p4.pt3.j = p4.pt2.j-li;
 p4.pt4.i = p4.pt3.i+li;          p4.pt4.j = p4.pt3.j+lj;
 }

if(l > 1.0)
 { hilbert_propagation(it,&p1);
  hilbert_propagation(it,&p2);
  hilbert_propagation(it,&p3);
  hilbert_propagation(it,&p4); }
else /* termination */
 { store_hilbert_elem(it,&p1);
   store_hilbert_elem(it,&p2);
   store_hilbert_elem(it,&p3);
   store_hilbert_elem(it,&p4);
 return; }
}
```

```
main()
{
char name_path[32];
int size;
FILE *fp;
Itile it;

Hilbert_Elem p;
printf("enter name path under which the Hilbert path will be stored:
");
scanf("%s",name_path);
fp = fopen(name_path,"w");
printf("enter size of square path (in pixels, must be power of 2!!):
");
scanf("%d",&size);
size = 32;
alloc_itile(size*size,2,&it);
strcpy(it.descr,"hilbert_curve");
it.nr = size*size;
it.nc = 2;
it.min = 0;
it.max = size;
hilbert_initiation(size,&p);
hilbert_propagation(&it,&p);
write_itile(fp,&it);
}
```

Annex 2

```
permut_2D(seed,n,a)
 int seed,n,**a;
{
int i,*b,c[2],d[2];
b = (int *) ivector(n*n);
ran_perturb(seed,n*n,b);
/* replaces the n x n elements in vector b by a random permutation*/
c[0]=c[1]=n;
for(i=0;i<n*n;i++)
 {
 calc_index_from_lin_addr(2,c,b[i],d);
/* transforms the linear address b[i] into a coordinate pair in
vector d */
 a[d[0]][d[1]] = i;
 }
free_ivector(b);
}

/*** RECURSIVE CALCULATION OF 2D ORDER ***/
recurs_order_calc(sd,lv,tp,nb,ib,jb,od)
 int *sd,lv,*tp,nb,ib,jb;
 Itile *od;
{
int i,j,**ma,sz,ba;
sz = tp[lv];
ma = (int **) imatrix(tp[lv],tp[lv]);
permut_2D(sd,sz,ma);
for(i=0,ba=1;i<lv;i++)
 ba *= tp[i];
if(lv == 0)
 {
 for(i=0;i<sz;i++)
  for(j=0;j<sz;j++)
   {
   od->elem[nb+ma[i][j]*ba*ba][0] = ib+i*ba;
   od->elem[nb+ma[i][j]*ba*ba][1] = jb+j*ba;
   }
 return;
 }
for(i=0;i<sz;i++)
```

```
 for(j=0;j<sz;j++)
recurs_order_calc(sd,lv-1,tp,nb+ma[i][j]*ba*ba,ib+i*ba,jb+j*ba,od);
free_imatrix(sz,ma);
}

main()
{
char name_path[32];
int n,seed,level,topol[5],**order;
int size;
FILE *fp;
Itile it;

printf("enter name of path: ");
scanf("%s",name_path);
fp = fopen(name_path,"w");
/* "size" is the size of matrix over which error propagation will
take place */
size = 32;
/* this matrix will be "level" times recursively subdivided into
subsquares */
level = 4;
/* "topol" describes the subsequent size of these submatrices */
topol[0]=2; topol[1]=2; topol[2]=2; topol[3]=2; topol[4]=2;

alloc_itile(size*size,2,&it);
strcpy(it.descr,"cr_path");
it.nr = size*size;
it.nc = 2;
it.min = 0;
it.max = size;
seed = -1;
recurs_order_calc(&seed,level,topol,0,0,0,&it);
write_itile(fp,&it);
}
```

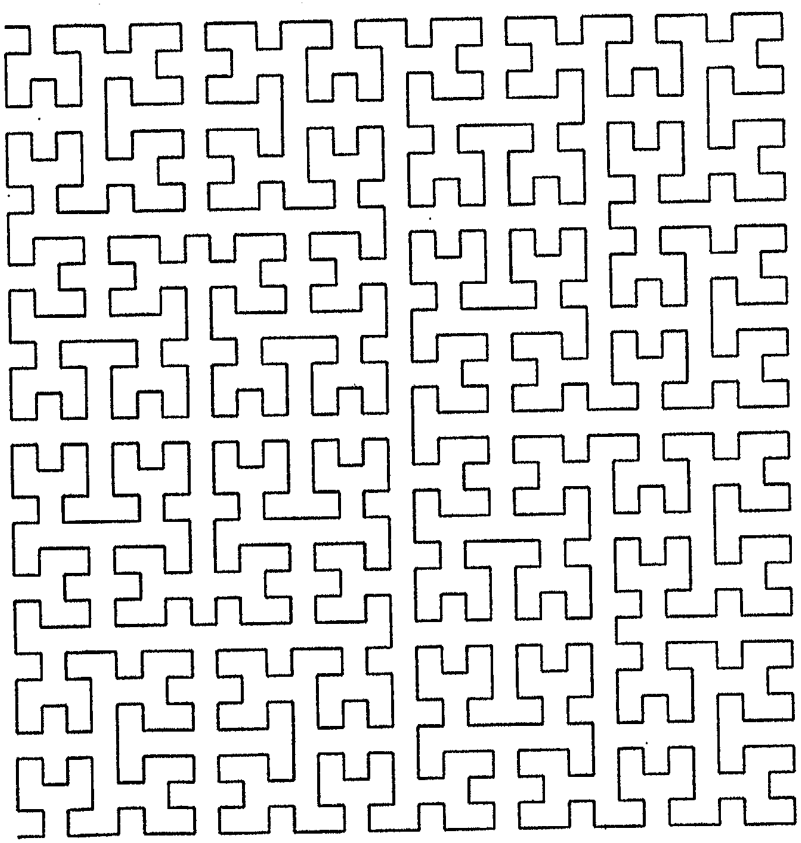

FIGURE 1A

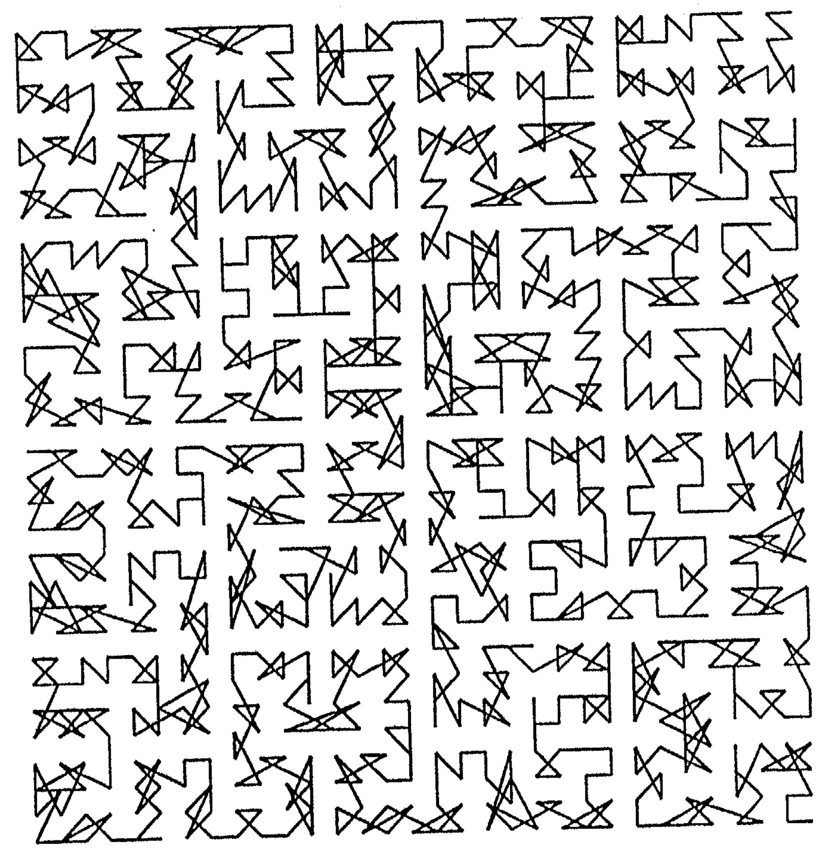

FIGURE 1B

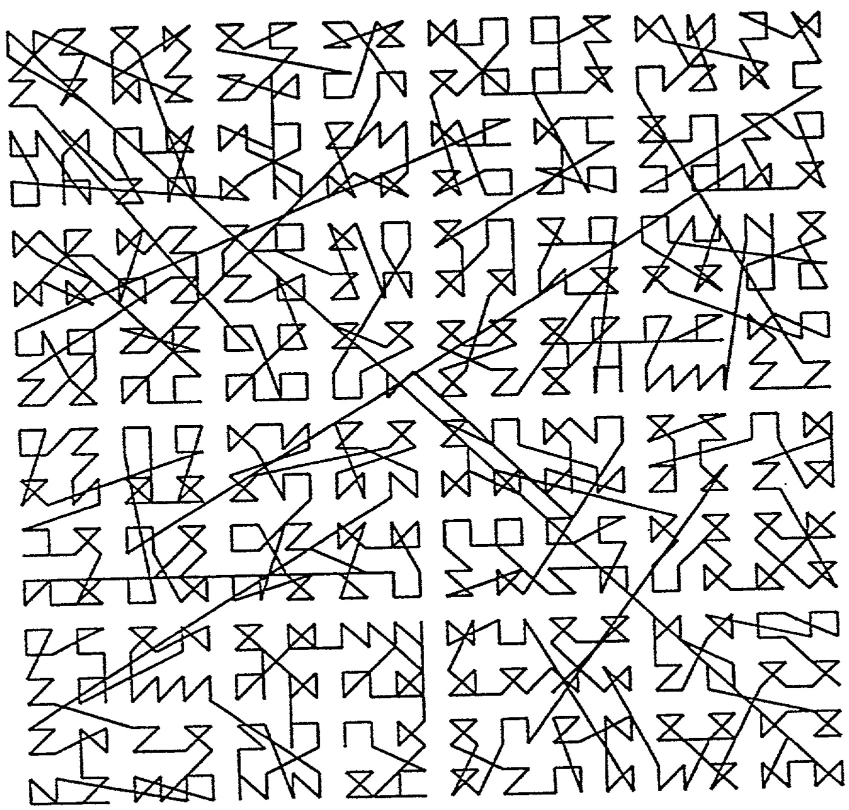

FIGURE 2

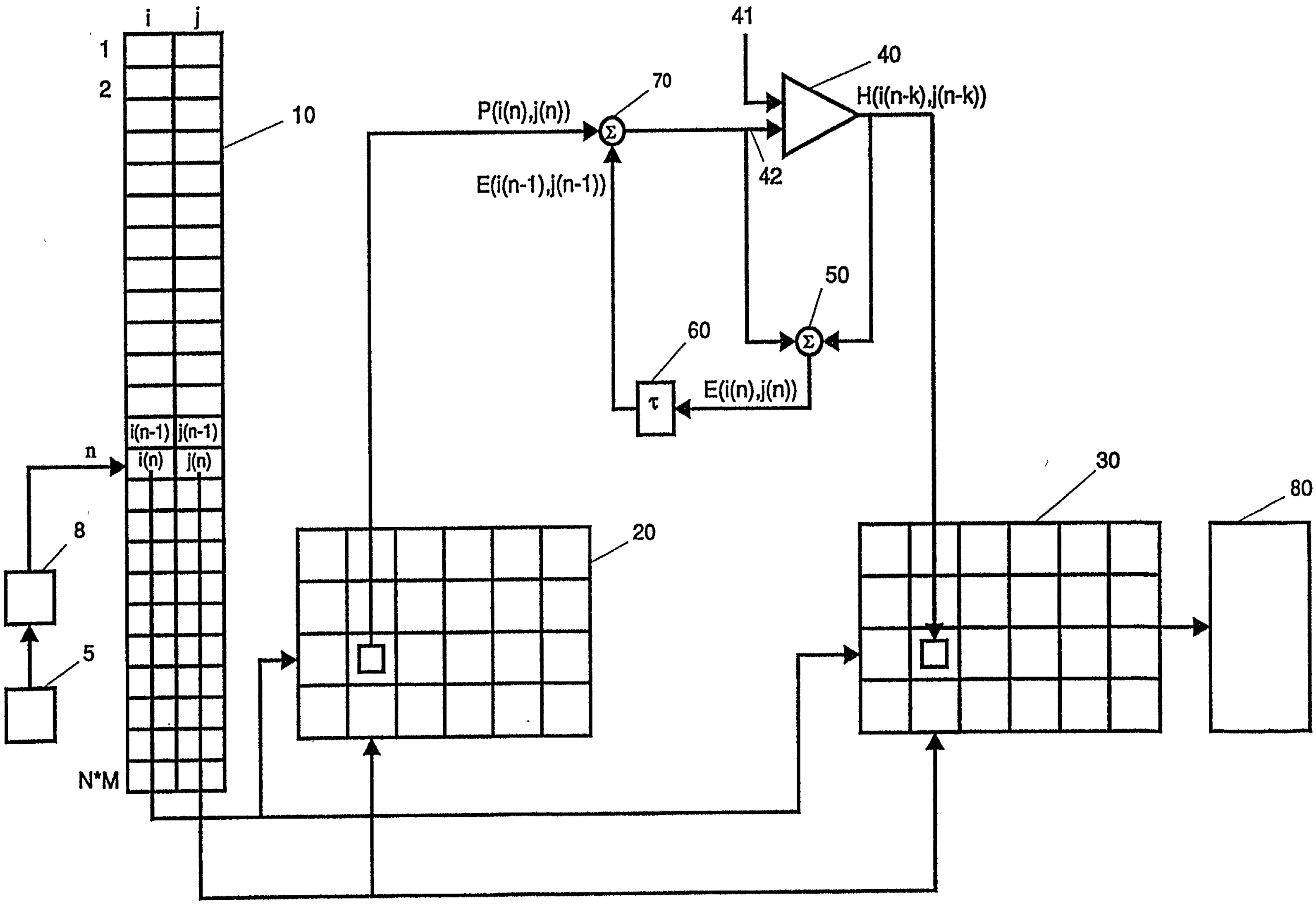
i
j
1
2
10
i(n-1)
j(n-1)
i(n)
j(n)
n
8
5
N*M
20
P(i(n),j(n))
70
E(i(n-1),j(n-1))
41
40
42
H(i(n-k),j(n-k))
50
60
E(i(n),j(n))
30
80

FIGURE 3

DECLARATION and POWER OF ATTORNEY

As a below-named inventor, I hereby declare that :

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled : Method for making a lithographic printing plate, the specification of which

[x] is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims,

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56,

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s) of which Priority is to be claimed :

Application Number : EP 93201115.8   Multilateral Treaty : European Patent Convention

filing date : April 16, 1993   designated State : i.a. DE
receiving office : European Patent Office
The Hague/Netherlands

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith :
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(1)

CRSCMN

DECLARATION AND POWER OF ATTONEY

I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true ; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

---

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Inventor's signature

Date: January 13, 1994

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